To:
The Minister of Agriculture, Nature and Food Quality
PO Box 20401
2500 EK The Hague

TCB S16(2005) 29 April 2005

Subject: Advice on the more sustainable use of agricultural land

Dear Minister,

In your letter of 15 July 2004 (reference DP.2004/923) you and the State Secretary for Housing, Spatial Planning and the Environment asked the Technical Committee on Soil Protection to prepare an advisory report on the sustainable use of agricultural land. Your main question to the Committee was 'What constitutes sustainable use of agricultural land and what are the roles of the various actors (government, industry) in such sustainable use?'

The findings of the Committee are set out in the attached report (A36, 2005). It interpreted your request as meaning that it should spell out in concrete terms what its earlier advisory report 'Towards a more ecologically sustainable land use'[1] means for the agricultural sector, interpreting the term 'ecological' in a broad sense. Given the function of the Committee, it approaches the more sustainable use of agricultural land from a soil protection viewpoint.

Agricultural land is being used unsustainably in the Netherlands. Unsustainable farming has many aspects (contamination, compaction, surface sealing, erosion and subsidence). Sooner or later this will lead to a deterioration in the productivity of the soil, poorer food quality, poisoning of ecosystems and a reduction in biodiversity. It will also reduce the efficiency of fertilisers, pesticides and energy, and therefore increase farmers' costs. Unsustainable land use is an insidious, diffuse problem which can easily go unrecognised. Recent research suggests that worldwide some 10 to 20% of agricultural land is being used unsustainably, thereby impairing its productivity. In the Netherlands soil degradation due to unsustainable use of the land is thought to be less serious. Unsustainable farming practices are nevertheless causing other adverse impacts both on farmland and elsewhere.

[1] TCB A33(2003).

The Committee regards the shift to more sustainable land use as a cornerstone of the Transition to Sustainable Agriculture and develops this idea further in its report. It advocates sustainable solutions which recognise that much of the land in the Netherlands is managed by farmers. Farmers who in their husbandry practices take special account of societal goals for landscape, wildlife and the management of soil and water, for example, should be recompensed for this. The Committee's analysis shows, however, that more sustainable use of agricultural soil is not only a matter of taking account of the wishes of society. It also often involves mitigating adverse effects which farmers inflict on their own land as well as the environment. It is very important to take a long-term view in this regard.

This report identifies objectives for more sustainable use of agricultural land, and where possible indicates how these objectives could be met. The Committee is of the opinion that it is not yet possible to rely exclusively on setting standards for the minimum and the desired soil quality needed to implement sustainable land use. Because the soil responds slowly to human actions and the problems are serious it will also be necessary to regulate these activities directly for the time being. A mass balance approach at the level of the individual farm is advocated.

It is clear that agrichains have a major impact on farming methods and therefore the way farmers use the soil. Codes of good practice for these product chains, and guidelines on sustainable land use, could make an important contribution to making the use of agricultural land more sustainable. The Committee considers that the drafting and implementation of such instruments should be energetically promoted.

I have also sent a copy of this letter to the State Secretary for Housing, Spatial Planning and the Environment.

Yours sincerely,

Ir. L.E. Stolker-Nanninga.
Chairman, Technical Committee on Soil Protection

ADVISORY REPORT

MORE SUSTAINABLE USE OF AGRICULTURAL LAND

This report was adopted on 6 April 2005.

For the Committee

Ir. L.E. Stolker-Nanninga, Chairman

Dr. J. van Wensem, General Secretary

TCB A36(2005), THE HAGUE
April 2005

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SUMMARY

The Technical Committee on Soil Protection (hereafter referred to as the Committee) was requested by the Minister of Agriculture, Nature and Food Quality to prepare an advisory report on the sustainable use of agricultural land and the roles of the various actors concerned. The Committee interpreted the request as meaning that it should spell out in concrete terms what its earlier report 'Towards a more ecologically sustainable land use' means for the agricultural sector. The term 'ecological' here is interpreted broadly as referring to soil fertility, adaptive capacity and resilience, buffer and reactor functions, biodiversity, resistance to disease and pests, and physical soil structure.

Having regard to the Committee's function, sustainable land use in agriculture is considered from the soil protection perspective. The starting point for our analysis is that the actions of the soil manager, in this case the farmer, affect soil quality. Objectives for more sustainable land use require an understanding of soil quality and of the activities which affect this quality. This report describes the context of, and qualitative and quantitative objectives for, sustainable land use, and considers the instruments that could be deployed to make land use more sustainable.

The agriculture sector is in a state of flux. Farmers' incomes are coming under pressure and employment in agriculture is declining. Although progress has been achieved with the environment, agricultural land is still being farmed unsustainably. The manner in which land is used depends on the tillage regime of the farmer. The latter is strongly influenced by the market. The farmer is confronted with a large number of regulations, enacted and enforced by the various tiers of government. Farmers often feel squeezed between the rigours of the marketplace and ever tightening environmental requirements, and this is eroding some farmers' support for more sustainable land use. Some years ago the government launched the Transition to Sustainable Agriculture initiative. A whole range of activities were organised in collaboration with industry, NGOs, research institutes and local and regional government. More sustainable land use has not yet received a great deal of attention in this initiative. The Committee regards the shift to a more sustainable land use as a cornerstone of the Transition to Sustainable Agriculture and develops this idea further in this report.

The Committee defines more sustainable land use from the perspective of soil protection as preventing present land use from having adverse impacts elsewhere and in the future, being able to maintain the present land use in the long term, ensuring that other land uses can be practised in future, and preserving ecological services of general importance. Using six

guidelines for sustainable use of the soil ecosystem, objectives have been derived for the soil quality parameters organic matter, nutrients, other substances, functional biodiversity and physical soil quality. The objectives can be summarised as follows:

- To ensure a minimum content of organic matter in the topsoil, this minimum to depend at least on soil type. In some situations the proportion of organic matter in the topsoil probably needs to be increased to enhance general soil biodiversity, permit a future change in land use, reduce the risk of leaching, and improve the structure and moisture retentiveness of the soil.
- To minimise the leakage of nutrients to groundwater, surface waters and the atmosphere in accordance with the ALARA principle. Bring inputs and outputs into balance after allowing for reuse and unavoidable losses in the Netherlands.
- For other substances (metals, veterinary medicines, pesticides), to seek a standstill at levels consistent with a good topsoil quality. A distinction needs to be made between substances which are still accumulating (metals, probably some pesticides), and substances where the content has stabilised, but at such a high level that they leach out or evaporate into their surroundings, with harmful results (exceedance of standards).
- Functional biodiversity: to maintain or, where deficient, augment the organic matter content of the topsoil, introduce cultivation-free field margins, maintain or extend the ‘green-blue meander’ (interconnected network or ‘lifeline’ of linear water and green elements) in the environment, and maintain a diversity of landscape features.
- Physical soil quality. To reduce or stop and where possible reverse subsidence, waterlogging, surface sealing, wind and water erosion. To preserve geological features in agricultural land. To maintain and extend the green-blue meander. To protect the characteristic agricultural landscape.

It is not a simple matter to lay down general rules for applying the standstill and ALARA principles in the extensive agriculture sector. This is because of the great variety of different media, substances and their different properties, baseline situations and possible techniques. Standstill means the same in the agricultural as in other sectors. In relation to the addition of materials to the topsoil which will become part of that soil, the rules already recommended for the addition of earth and dredging spoil can be applied.

The Committee does consider that it would be sensible to adopt a minimum and a desired soil quality for different parameters, but points out that it is not a simple matter to quantify these precisely. The term minimum quality suggests the minimum quality needed for agricultural use and for wider societal goals. We have indicated the parameters which could form the basis of a minimum quality. Desired quality is related to the concept of ‘suitability for

use', which must play an important role in farming regimes. For contaminants, target values can be used. The Committee is also following developments with regard to the 'reference biological soil quality'.

In formulating objectives for more sustainable land use we consider the relative merits of regulating outcomes and means, and the scope for region-oriented environmental policy and duty of care. While the Committee generally favours regulating for outcome and a region-oriented approach, it is aware that, for different reasons, the conditions are not yet ripe for policies of these kinds. With regard to a duty of care for land, the desirability is addressed of differentiating between the interests of farmers themselves and of society as a whole. A duty of care for the broader good could justify subsidy. Based on existing regulations it is concluded that farmers who use their land to achieve socially desired objectives and thereby incur demonstrable costs could be recompensed. The objectives formulated by the Committee for more sustainable land use would then qualify for limited incentives.

Indicators can be used to measure trends in land use. Because this report is concerned not only with soil quality but also with actions which affect this quality, a distinction is made between state indicators and use indicators. No fixed criteria have yet been established for state indicators. So-called 'amoebas' (methods for describing and assessing ecosystems) can be used here, where the value of an indicator is expressed relative to a reference situation. The choice of reference situation is very normative, and therefore a political decision. There is little experience of how indicators can relate precisely to soil management. This relationship will have to be established empirically. Use indicators are based on mass balances for organic matter, nutrients and other substances at the farm level. Because the soil responds only slowly to human activity, and degradation is difficult to reverse, use indicators are preferable where possible.

Finally, a number of concrete measures not mentioned earlier are proposed which can be taken by farmers, the agrichains, society and government to bring sustainable land use closer.

1 INTRODUCTION

The Minister of Agriculture, Nature and Food Quality, in conjunction with the State Secretary for Housing, Spatial Planning and the Environment, requested the Technical Committee on Soil Protection (hereafter referred to as the Committee) to prepare an advisory report on the sustainable use of agricultural land (letter dated 15 June 2004, ref. DP.2004/923). The Minister's main question was:

> '*What constitutes sustainable use of agricultural land and what are the roles of the various actors (government, industry) in such sustainable use*?'

The Minister indicated in his letter that there is a need to make the concepts more precise and concrete by determining exactly what sustainable (or more sustainable) land use in agriculture actually means. There needs to be a common understanding of what sustainable land use in agriculture is. The Committee has interpreted these questions as a request to spell out in concrete terms what its general philosophy on more sustainable land use means for the agricultural sector. The Minister asked the Committee to give proper weight in its analysis to the sociocultural, ecological and economic dimensions of sustainable development in agriculture.[1] In this introduction we formulate a definition of more sustainable land use in agriculture and outline the technical background to this report.

WHAT CONSTITUTES SUSTAINABLE USE OF AGRICULTURAL LAND?

From 2000 to 2003, the Committee pursued a number of activities related to more sustainable land use. It drew up three advisory reports on the role and importance of soil ecosystems (TCB, 2000a; 2000b; 2003).[2] The last of these, 'Towards a more ecologically sustainable land use', sought to define what more sustainable use of the soil actually means from the perspective of soil protection. A set of essays was published specifically for the agriculture sector entitled 'The soil and sustainable agriculture' (Oenema, 2003a), and a conference was held with the same title.[3]

The core task of the Committee is to give the government technical advice on implementing the law and policy on soil protection. Sustainability issues need by definition to be addressed from a broad perspective, because account has to be taken of the sociocultural, ecological

[1] These dimensions embody the 'Three Ps principle': People, Planet, Profit
[2] The first two reports are appended as annexes to the third report.
[3] The conference 'The soil and sustainable agriculture' was held on 23 October 2003 in the Reehorst, Ede.

and economic dimensions. In view of the Committee's area of expertise, it cannot take such a broad perspective. In our reports we confine ourselves to just one of the three pillars of sustainability, i.e. the ecological dimension; in this case, that of agricultural land use. In its earlier report the Committee argued that there is a hierarchy in the three dimensions, the ecological dimension being a precondition for the economic and sociocultural dimensions (TCB, 2003). We therefore consider more sustainable use of agricultural land from the perspective of soil protection.

More sustainable land use is land use that is consistent with sustainable development. The land is used in such a manner as to satisfy society's present needs, without compromising the ability of future generations to meet their own needs. The *ex ante* evaluation of the soil memorandum (Tiktak *et al*., 2004) summarised this definition as 'land use which does not limit its future use or the use of land elsewhere'. If we interpret the concepts of land use in the future and elsewhere widely, so as to include for example the role of the soil in the large-scale hydrological and material cycles, then this definition accords with our earlier report 'Towards a more ecologically sustainable land use' (TCB, 2003), where we described what we understand by more sustainable land use. It was seen that it is easier to describe in general terms what more sustainable land use should look like than to define precisely what it is. The nature of the Committee and its function means that the focus, in considering more sustainable land use, is on the management and maintenance of ecological services, and on the constraints imposed by the soil-water ecosystem (suitability for use).

A definition of more sustainable land use from the soil protection perspective might be:
More sustainable land use means preventing present land use from having adverse impacts elsewhere and in the future, the ability to maintain the land use in the long term, ensuring that other land uses can be practised in future and preserving the ecological services of general benefit.

Of course, whether or not land use is regarded as sustainable depends on:
a) the time and geographical scales considered;
b) the economic and sociocultural situation, and
c) society's current norms and values.

Absolute assertions cannot be made about sustainable land use. For this reason the Committee prefers to use the term 'more sustainable' land use.

TECHNICAL BACKGROUND

It is not possible to discuss sustainability without first deciding on the timeframe to be considered. The timeframes which matter to different actors vary considerably. A farmer can afford only one bad harvest, national and regional economies can survive an economic crisis which lasts up to three years, while ecological sustainability involves a term of 10 to 100 years. This is the timescale over which processes in the soil-water system undergo major impacts. Of course ecosystems can suddenly 'flip', after a long period without much visible sign of change, into a degraded state which is irreversible (e.g. erosion and desertification).

Land use can be looked at on different levels. At the highest level there are major generic usages of land by society: agriculture, forestry, urbanisation, infrastructure (surface and sub-surface), recreation, conservation, water supply and mining. At a lower level agriculture can be subdivided into different types of farming, such as dairy, arable, extensive (non-greenhouse) horticulture, bulbs, fruit cultivation, etc. And these forms can themselves be further subdivided into different tillage methods, resulting in differences in land use on a yet smaller scale.

As before, the Committee distinguishes between the 'local scale' and the 'environment'. The local scale in agriculture is the scale of the farm, comprising the buildings, installations and the topsoil (root layer).[4] The term 'environment' is used here to mean all the environmental media beyond the farm: air, deeper soil including groundwater and surface waters including sediments. In its earlier report on more sustainable land use the Committee indicated that on the local scale soil is managed to further the interests of the user himself. As far as the environment is concerned however, the general interests of society as a whole come into play.

In considering more sustainable land use we can look at soil quality or at the actions which affect this soil quality. The starting point for our analysis is that the actions of the soil manager, in this case the farmer, affect soil quality. If we seek to use agricultural land more sustainably, we must understand the relationship between soil quality and the actions which affect that quality. For soil quality the Committee focused on the main parameters: organic matter, nutrients, other substances, functional biodiversity and physical soil quality.

Agriculture uses land in different ways. Land-extensive agriculture makes direct use of the land to produce a wide range of crops. In land-extensive animal husbandry the land is used

[4] In agriculture the term 'tillage layer' is used. Here we use the term 'topsoil' (root layer), because the layer just under the tillage layer is also of practical interest.

to produce livestock and to process their manure. It also forms the ‘substrate’ for buildings, installations and grazing cattle. Land outside the farm is also used, to a greater or lesser extent, for both the production of cattle feed and the processing of manure. This land may be located in third world countries, for example. The extreme situation is the intensive livestock industry, where all the raw materials are brought in from outside and all its manure is taken elsewhere. All farms bring in raw materials from outside and send away their products and, where relevant, waste products for further use; the differences are only a matter of degree. In principle all farms can draw up a mass balance of their inflows and outflows of particular substances, and thereby calculate any accumulations, deficits and losses on the farm.

This report regards land as a crop production resource and a processor of residues and wastes. Residues and wastes are applied to the soil in order to provide it with nutrients and organic matter. As far as farm buildings and installations are concerned, the Dutch Soil Protection Guidelines provide a regulatory basis, with the measures to be taken (mainly isolation and monitoring) being based on the likelihood of substances being discharged into the soil and groundwater. No further attention will be paid to this type of land use in the report.

STRUCTURE OF THIS DOCUMENT

Chapter 2 gives a brief outline of recent developments in agriculture, which form the context within which we wish to move towards a more sustainable use of agricultural land. The relationship with the Transition to Sustainable Agriculture is described.

Chapter 3 formulates possible objectives for more sustainable land use in agriculture from the perspective of soil protection. For this purpose we refer back to previously formulated guidelines for more sustainable use of soil ecosystems (broad definition). Objectives are then formulated for each soil quality parameter, using the *standstill* and ALARA principles and the concept of minimum and desired soil quality. These objectives are developed further in specific relation to agriculture and the parameters which apply to it.

Chapter 4 discusses instruments which could be used by the authorities, but also other actors, to achieve the objectives described in chapter 3. This chapter examines the relative merits of regulating outcomes and means, the use of region-oriented policy, duty of care, indicators for monitoring and concrete measures to promote more sustainable use of farmland.

Chapter 5 then concludes by addressing and answering the specific questions raised in the request for advice, based on the preceding chapters. This chapter can be regarded as the Committee's conclusions and recommendations.

2 CONTEXT

This chapter describes the context within which we wish to move towards a more sustainable use of agricultural land. The economic and sociocultural developments in agriculture are first briefly summarised. The state of the environment and the transition to sustainable agriculture are then discussed.

AGRICULTURE IN THE NETHERLANDS

The Netherlands practises a very intensive form of agriculture, characterised by high per-hectare production. Large volumes of raw materials are imported, sometimes from third world countries. Dutch agriculture is very export-oriented. Over two-thirds of revenues and employment are accounted for by the exports of – principally – flowers, meat, dairy products, vegetables and tobacco (Ministry of Agriculture, Nature and Food Quality, 2004). Nowadays farms account for only a small part of the revenues generated by what is referred to as the Dutch agrocluster, or agrofood complex. The agrofood complex as a whole is responsible for 10% of GNP.[5] Primary agriculture itself accounts for about 20% of this, while the rest relates to raw materials, processing and distribution (Ministry of Agriculture, Nature and Food Quality, 2004).

The Dutch agriculture sector is in a state of flux. Over the period 1984-2004, for example, the total cattle herd in the Netherlands declined from 5.5 to 3.8 million. This is in part due to the introduction of milk quotas in 1983. The number of cattle farms fell over this period from 80,000 to 38,000. The average herd size per farm increased. The number of milk cows per hectare fell. Dairy now accounts for 70% of the bovine herd compared with 82% twenty years ago (Statistics Netherlands, 2005).

Looking over a longer period, 2004 marked a new low in the incomes of the agriculture/horticulture sector, after a number of similarly indifferent years (LEI, 2004). The revenue generated by Dutch agriculture fell by 12% in 2004 compared with 2003, the largest drop in the European Union. Employment in Dutch agriculture fell by 2%. The drop in revenues in 2004 was mainly caused by lower prices of agricultural products and higher costs. Farm production in 2004 actually increased by 1.5% compared with 2003. The share of primary agriculture in the total economy fell from 4% to 2% between 1985 and 2004 (Statistics Netherlands, 2004). Some commentators refer to an economic marginalisation of Dutch agriculture after 1990 (Stolwijk, 2004).

The prices of raw materials, land and labour are high while the prices farmers receive for their produce are low, indeed often below cost price. Enlargement has added huge tracts of agricultural land to the European Union (EU). In these areas labour and land are still relatively cheap. Competition from products from these areas is making itself felt. Export subsidies for agricultural exports from the EU are under discussion, and will eventually be at least partially dismantled. Subsidies on agricultural products within the EU will also disappear, and will increasingly be replaced by income support bound to certain conditions.

In its report *Meerwerk* (2004), the Council for Housing, Spatial Planning and the Environment considered the relationship between Dutch agriculture and spatial planning. The report contains a detailed description of the economic, sociocultural and environmental state of Dutch agriculture and expected developments in the future. No further attention, therefore, will be devoted to these topics here, except in so far as these matters touch on more sustainable land use and the effects on land use in agriculture.

STATE OF THE ENVIRONMENT AND THE SOIL

There has been a clear reduction in the environmental impact of agriculture since the 1980s (Doornbos, 2003). To some extent, agriculture is struggling with a legacy from the past. Historical accumulation of phosphate and metals in the soil, for example, will continue to give rise to regulatory problems over the next few decades.

More and more farmers are organising themselves into nature conservation associations and environmental cooperatives. In 2001 it was revealed that 20% of the 1.9 million hectares of land under cultivation is managed by farmers belonging to an environmental cooperative or agricultural conservation association (Oerlemans *et al*., 2001). De Snoo (2005) found that the farmland covered by agricultural conservation associations now accounts for over half the countryside.

Farming methods depend on international chains of food processors. These chains can process Dutch agricultural produce, but do not need to (Ministry of Agriculture, Nature and Food Quality, 2004). They make demands on the way crops are cultivated and control the prices. There is little scope for negotiation on production methods or prices, because the food processing chains can easily buy their produce elsewhere. There is growing awareness on the part of these agrichains of sustainability issues, probably mainly driven by consumer fears about food safety.

[5] Gross national product.

In his purchasing of raw materials such as fertiliser, compost, roughage, feed concentrate, pesticides and veterinary medicines, the farmer is guided mainly by price and effect. Quality and possible environmental impacts vary greatly however. Suppliers influence farmer choice through pricing and product information.

The regulatory authorities and institutions also influence farming methods. Municipalities issue the necessary environmental permits and make land-use plans. In future municipalities may be able to exercise some control through soil management plans which set soil quality goals. Agriculture being a sensitive function, these goals will probably be based on longer-term targets for soil quality. Water boards also influence agriculture through water table management policies and their supervisory role in relation to the dredging of water courses. Provincial authorities pursue policies on, for example, groundwater protection, spatial planning, landscape, water and nature conservation that impact on individual farmers. Central government has a major role in regulating agriculture and implementing European law. There are regulations on the quality and use of manure, pesticides, food safety, ploughing up of pastures, the emissions from animal housing, etc. There are different subsidy and compensation schemes for agricultural stewardship, meadow bird management, crop damage caused by, for example geese and wild swans, restrictions when there are nearby nature conservation areas, etc.

Until the 1990s the government and the EC promoted increased and larger-scale agricultural production. As a result of increasing public pressure, the government is now beginning to introduce restrictions. This led in the past to a breakdown in trust between the government and the agricultural community, and this has eroded some farmers' support for more sustainable land use.

In its previous report on more sustainable land use the Committee pointed out that many forms of agriculture are not sustainable (TCB, 2003; see also Oenema, 2003a; Römkens & Oenema, 2004). A catalogue of international unsustainable land uses was published in a past edition of *Science* (2004). But there has been no systematic research into unsustainable land use in agriculture; much work is based on descriptions of incidents. The unsustainability is then mainly based on expert judgement. A list of unsustainable agricultural practices has been compiled below based on an expert working group[6] and the Committee itself, subdivided according to the quality parameters mentioned earlier – organic matter, nutrients,

[6] J. van den Akker, J. Bloem, D. Boels, P. Römkens, G. Velthof, K. Zwart and O. Oenema (Committee member, convoker), all working at Wageningen UR, Alterra.

other substances and physical soil quality (functional biodiversity is not discussed). The list is not exhaustive and each group concludes with references from the literature.

Organic matter

- Continuous maize culture (without second crop or intertillage): this depletes the organic matter and leads to soil compaction.
- Ploughing up pastureland particularly in the autumn, causing loss through mineralisation.
- Drainage, leading to oxidation of the naturally occurring organic matter.
- Contract bulb cultivation, combined with the use of pesticides. This form of agriculture is sometimes seen as an antidote to monoculture with its attendant high pressures from the use of plant disinfectants and pesticides. The disadvantage, however, is the lack of care with which the leased land is treated. This also applies to other crops grown under contract.

For more information on organic matter in Dutch agriculture see: Reijneveld *et al*., (2005, in preparation), Vellinga *et al*. (2004), Velthof & Oenema (2001) and Lloyd (1992).

Nutrients

- Diffuse but continuing build-up of phosphate in the soil.
- Application of animal manure in autumn, because of leaching and run-off to groundwater.
- The ploughing up of pastureland in autumn, due to wash-out of soil.

For more information on nutrients in agriculture see: RIVM (2004), Schoumans *et al*. (2004), Willems *et al*. (2004), VandenAuweele *et al*. (2004, for Belgium) and RIVM (2002).

Other substances

- Diffuse but continuing build-up of heavy metals and veterinary products in the soil, for example from the relatively extensive use of pesticides.
- Relatively heavy use of pesticides.

For more information on other substances in Dutch agriculture see: De Vries *et al*. (2004), Lahr (2004), Römkens *et al*. (2003), Delahaye *et al*. (2003), Nooteboom (1999) and De Snoo & De Jong (1999).

Physical soil quality

- Use of excessive wheel loads and tyre pressures; driving tractor in the furrows during ploughing; use of heavier and larger machinery.
- Maize cultivation on peaty substrates.
- Crop harvesting in wet conditions.
- Water management in peatland.
- Certain forms of deep ploughing and unnecessary turning of the soil.

For more information on physical soil quality in agriculture see: Van den Akker (2003), Alblas *et al*. (1994) and Boels (1981).

CHANGE AND TRANSITION

In the report 'Quality and the future', sustainability is examined by reference to four scenarios extending from now until 2030 (MNP-RIVM, 2004). The scenarios differ in the degree to which the activities are integrated internationally, and in the trade-off between efficiency and solidarity.

One of the subjects examined is the food supply. On the basis of a Europe-only analysis, the food supply is unlikely to be endangered, although in the long term changes in yields due to climate change is an issue. Food security is expected to increase, although a series of new problems are expected to arise. The total revenues earned by European agriculture fall in all the scenarios. In global scenarios the land requirements of agriculture reduce; in regional scenarios the land requirements remain the same or increase. The reduction in land requirements will create opportunities for nature conservation and other uses of space, but there is a risk that characteristic landscapes of high ecological and scenic value, such as vineyards and olive groves, will disappear. In terms of the objectives formulated for sustainable development in Europe, it is striking that all scenarios show a deterioration for at least one of the environmental indicators (land requirements, nitrogen emissions, landscape, water use and animal welfare). The only scenario which indicates an improvement for two of the environmental indicators shows a deterioration for the other three.

The government would like the Netherlands to be a sustainable society within thirty years. Radical changes will be needed in society, both nationally and internationally, if this is to be achieved. In the Fourth National Environmental Policy Plan (Ministry of Housing, Spatial Planning and the Environment, 2001), the environmental problems in agriculture are characterised as complex and intractable. A shift towards sustainable agriculture is also being actively pursued for economic and sociocultural reasons.

Progress towards sustainable development in agriculture, and therefore more sustainable land use, depends on many economic and social factors that are unrelated to the soil and which are now evolving rapidly. The complex interplay of economic and social factors and society's changing attitudes to agriculture make it difficult to chart a clear path to sustainable development in agriculture. The Centre for Agriculture and Environment presented its vision of sustainable development in its report 'Towards a sustainable agriculture in 2030'. This looks back from the vantage point of 2030 to see how more sustainability could have been achieved. This 'backcasting' exercise illustrates the complexity of the required transition (Van der Weijden & Hees, 2002).

The Transition to Sustainable Agriculture seeks to trigger a lasting technological, economic, sociocultural and institutional transformation. Agriculture in its present form has undesired impacts on the environment, spatial quality and animal welfare. The objective is to transform agriculture into a sustainable, internationally competitive sector over the next 30 years. Sustainable agriculture will employ clean production methods, contribute to the global food supply, produce safe food, comply with standards for animal welfare, help preserve wildlife and biodiversity and promote the conservation of characteristic landscapes and a thriving rural community (Ministry of Housing, Spatial Planning and the Environment, 2005).

The government initiates the transitions by means of 'transition arenas', i.e. networks of experts and pressure groups. Each transition arena comprises a partnership, a network and an independent facilitator. The facilitator is the agency which is part of the Innovation Network Rural Areas and Agricultural Systems (TDL, 2003). Innovation Network is an independent network of innovation-minded people. The people who work together in the network come from companies, NGOs, research institutes and public bodies. It was set up by the government in consultation with the other parties referred to. The network comprises a large number of groups working on themes and projects. The partnership for transition to sustainable agriculture includes representatives of the Ministry of Agriculture, Nature and Food Quality, Unilever, the Dutch Organisation for Agriculture and Horticulture LTO Netherlands, the Consumers' Association, the Social and Economic Council and the Dutch society for the protection of animals. The members make a personal commitment to the transition. The sub-themes of the Transition to Sustainable Agriculture are Vital Clusters, Versatile Countryside, International Agrifood Networks and Innovative Networks. Vital Clusters is about producing food sustainably. Versatile Countryside is concerned with the other products and services created by agriculture, for example spatial quality and quality-of-life in the countryside, water storage, nature management, care and education. Innovative Networks seeks to create networks between parties and organisations who will make

groundbreaking innovation. The government promotes, finances and supports initiatives in the transition arenas.

It is important to recognise that government cannot design the transition process on its own. Other parties need to be made jointly responsible for the necessary changes (Driessen, 2003). Industry innovates and is also an important partner in the search for new directions. Driessen (2003) argues that more freedom should be given to agricultural entrepreneurs to get the most desirable changes under way. Greater freedom for agricultural entrepreneurs will however also entail greater responsibility and therefore accountability.

Driessen describes the role of the government as:

- formulating basic standards to be complied with everywhere and always. Legal regulations and enforcement instruments play an important role in this;
- removing barriers and creating stimuli for desirable change. This may involve advice, funding research and/or providing financial support for change;
- quality assurance. This includes holding to account those responsible for quality;
- tightening standards, discontinuing support for measures which do not work.

The Ministry of Agriculture, Nature and Food Quality considers that one task of government is to promote a climate of enterprise, to help and facilitate without disempowering. Sustainability requires a vital agricultural sector. ‘Innovative companies deserve government assistance because innovation is costly, intensive and risky. Innovation which is socially desirable but not profitable should also be fostered’ (Ministry of Agriculture, Nature and Food Quality, 2005).

The Ministry of Agriculture, Nature and Food Quality would like to monitor whether the transition is going in the ‘right’ direction and whether progress is fast enough. This will allow it and the other parties concerned to adjust their objectives and instruments if necessary. Different monitoring systems have been developed (EC-LNV, 2004). The first results are expected shortly.

The Council for Housing, Spatial Planning and the Environment (2004) has concluded that agriculture is becoming decreasingly independent of the land. It urges the government to take responsibility in alleviating the impact on the countryside. The Committee thinks that sustainable land use can contribute to the preservation of extensive agriculture in the Netherlands. It regards this as desirable because extensive farms still have a major role in managing land and landscape in the Netherlands.

The Committee sees more sustainable land use as one component of the transition to sustainable agriculture, and has the impression that it has so far received scant attention in this context. More sustainable land use can help to give momentum to the transition by spearheading the necessary innovations in farming. In so doing, it can contribute to the clean production of safe food, to the conservation of wildlife and biodiversity and to the preservation of characteristic landscapes and a thriving rural community. With this in mind, this report looks in detail at what more sustainable land use in agriculture is, and how it can be put into practice.

3 OBJECTIVES

INTRODUCTION

This chapter sets out possible objectives for the more sustainable use of agricultural land from the viewpoint of soil protection. The guidelines previously formulated for more sustainable use of soil ecosystems will be used. For each of the five main soil quality parameters (organic matter, nutrients, other substances, functional biodiversity and physical soil quality), objectives are formulated for the desired soil quality and/or the activities which contribute to this quality. Some of the objectives correspond to the implementation of the standstill or ALARA principles for certain parameters, while others represent minimum or desired values for soil quality. These objectives are referred specifically to agriculture as far as possible.

It was stated in Chapter 2 that various ways in which farmland is being used are unsustainable. This is because they cause damage to the topsoil so that in time the land becomes unusable and/or it is difficult to convert the land to other uses and/or technical and chemical products have completely replaced the ecological services and/or they damage the environment. Identifying unsustainable forms of land use allows priorities to be set in the pursuit of a more sustainable land use. Land use can become more sustainable by stopping unsustainable practices.

In earlier reports the Committee proposed a number of guidelines for more sustainable use of soil ecosystems. These guidelines can be translated into agricultural practice. Where relevant and possible, objectives and the associated implementing instruments will be formulated for each soil quality parameter (organic matter, nutrients, other substances, functional biodiversity and physical soil quality).

1] Use of an ecological function should not lead to its exhaustion or destruction locally.

For agriculture this effectively means that the chemical, physical and biological factors which affect the natural fertility of the soil be used and maintained as far as possible. The natural fertility of the soil depends on, amongst other factors, the soil type. Organic matter is very important for soil fertility because of its role in the nutrient cycles, its capacity to deliver moisture, its natural resistance to disease and pests and for the soil structure. The objective for organic matter should in the first place be its maintenance at the present level (standstill) and (in the longer run) to increase its content in a number of soils. This objective will also help in meeting guidelines 2, 3 and 6. Sealing of the surface structure, waterlogging, rutting and erosion should also be avoided wherever possible.

Maintaining the natural fertility of the soil is of direct importance for the farmer. For organic matter, it would be possible to use a mass balance approach which accounts for inputs and outputs.

2] When one ecological function is used, the others should as far as possible remain intact locally.
Making optimum use of the natural fertility of the soil may have consequences for other functions of the topsoil. These consequences should be minimised. The contribution of the topsoil to, for example, the storage of CO_2, general soil biodiversity, the maintenance of the water and other material cycles and landscape is important to society as a whole, even though these ecological functions may not have a clear local agricultural benefit, at least in the short term.

Minimum values for the organic matter content (related to general soil biodiversity) and physical soil quality should be formulated. Nutrient levels in the topsoil should not be such as to impair the functioning of soil life. Other pollutants (metals, persistent organic compounds, veterinary products and pesticides) should be held below permitted values such as target values or the LAC (Agriculture Advisory Committee on Environmental Contaminants) warning levels. Compaction should be minimised or restored. These objectives are also important for guidelines 3, 4 and 6.

Maintaining other soil functions is mainly for the benefit of society as a whole, although there may also be some benefits to the farmer. Based on objectives, measures can be formulated that set minimum or desired soil quality, or implement standstill. For organic matter and other substances a mass balance approach could be adopted based on inputs and outputs.

3] The recovery capacity of the soil remains unimpaired; this means that the functions temporarily absent, possibly for a protracted period, must be able to return. This requires that all the organisms important for the soil ecosystem must be kept available.
Agriculture tends to break – or seriously interfere with – ecological cycles. These systems must be restored when the agricultural activity is discontinued. A reduction in soil acidity or a raising of the water table must be possible without the leaching from the top soil of unacceptable quantities of the accumulated nutrients and metals. The re-establishment of wildlife driven out by agriculture should not be held back more than temporarily by the presence of persistent toxic compounds, excess nutrients, a deficiency or excess of organic

matter or compaction of the soil. There must be ‘sources’ of species for their re-establishment in the near environment (see also guideline 5).

Maintaining the ability of the land to recover is a general societal good. The objectives have largely been formulated already under guidelines 1 and 2. This guideline also imposes requirements with regard to diversity in the environment and therefore the need for the green-blue meander. This objective also contributes to guidelines 4 and 5.

4] The rate of recovery should be commensurate with the rate at which the use is being changed. A recovery period of centuries is too long where the changes took place over 30 years.
There is some overlap with the previous point here. A transition to another type of ecosystem takes time, also in natural situations. When land is used by man, this by definition affects the soil quality, and extra time is needed for recovery. When change needs to be effected relatively quickly, as will often be the case in the Netherlands, it is desirable that the starting situation should be favourable for recovery.

As a rule of thumb, we could assume that a large-scale form of land use is not sustainable if the transition to another large-scale use cannot be effected within one generation (30 years, say). This would apply to a switch from agriculture to nature conservation for example. For a switch to another type of culture or tillage, for example from ornamental plants to food crops or from conventional to organic farming, a term of a few years would be reasonable.

It is in the general interest of society that soil should be capable of recovery from a large-scale form of land use within a reasonable term. Based on objectives, measures can be formulated in the form of minimum or desired soil quality.

5] All ecological functions must have the requisite space; this limits the scale on which use can occur.
The loss of functional biodiversity and the associated ecological services can be offset by ensuring a varied landscape and land use at a regional level. If a plot of farmland becomes available for other use, the variety practised in the vicinity can be established there. This is something of general benefit to society and has implications for spatial planning.

6] The use of the soil ecosystem must not harm the environment, such as the groundwater and adjacent ecosystems.

This means that agriculture must be conducted such that there is minimum leakage of nutrients, metals and other substances into the environment. The present levels of nutrients and metals in water are a historical legacy, caused by leaching to groundwater, and thence to surface waters. Models predict that it will be difficult to meet the standards of the Water Framework Directive (WFD) for phosphate and metals over large areas (Broers *et al*., 2004). Researchers warn that we are faced with a difficult choice over the coming years: either to accept that the WFD standards will be exceeded for a prolonged period or to cut drastically or stop the addition of phosphate and metals to the topsoil (or remove it). Both these options will be very costly. The impact on the environment of the evaporation of ammonia and certain pesticides is also a matter of concern. It is not clear whether the objectives for the deposition of ammonia set by the EU and the Fourth National Environmental Policy Plan (NEPP4) will be met.

Dutch agriculture presently makes a major contribution to the emissions of greenhouse gases. It accounts for about 50% of the national emissions of methane and nitrous oxide. The short-term objective for reducing the emissions of greenhouse gases in the Kyoto protocol and the commitments of the EU countries (at least 6%) are modest. Agriculture can easily meet this objective. The long-term objectives (see NEPP4) are much more ambitious (at least 60%), and will have a major impact on the sector.

Management of water levels for agricultural purposes has a major impact on ecosystems. Better account could be taken of society's other requirements when regulating water levels. It is difficult to formulate an appropriate objective for this, however.

Dutch agriculture has an impact beyond its frontiers. The land requirements for the production of imported fodder for the intensive livestock industry in the Netherlands is four times the total national area of agricultural land (Oenema, 2003b). This depletes fertility and leads to erosion in the exporting countries, and contributes greatly to nutrient excesses in the Netherlands (Smaling, 2003).

One possibility would be to require that there should be a balance on a national scale between the imports and exports of nutrients and perhaps other substances as well: the nutrients imported in animal fodder and fertilisers should not exceed those exported in, for example, livestock, crops and manure, allowing for unavoidable losses from the chain and reuse.

Pollution of the environment is an inadmissible effect which must be prevented as far as possible. The ALARA principle could be adopted to regulate the 'unavoidable' losses, combined with best available techniques or best practicable means. For other substances the standstill principle would apply. Where substances break down into harmless compounds, these would be treated as outputs in the mass balance.

OBJECTIVES PER SOIL QUALITY PARAMETER

Objectives for the use of soil ecosystems were formulated in the preceding section based on a number of guidelines. This analysis allows us to set the following objectives for the different soil quality parameters:

- For organic matter a minimum content in the topsoil, dependent at least on soil type. In some situations an increase in the organic matter content of the topsoil is probably necessary in terms of: general soil biodiversity, scope for changing the land use, reducing leachability, improved soil structure and moisture retention in the soil.
- Minimise leakages of nutrients to groundwater, surface waters and air, based on ALARA. Bring imports and exports into balance, allowing for reuse and unavoidable losses within the Netherlands.
- For other substances (metals, veterinary products, pesticides), seek standstill at levels corresponding to a good quality topsoil. A distinction must be made between substances which are still accumulating (metals, probably some pesticides), and substances which have stabilised at such a high level that they leach out or evaporate into the environment causing adverse effects (exceedances of standards).
- Functional biodiversity: maintain – or augment where levels are low – the organic matter in the topsoil, introduce uncultivated field margins, preserve or extend the green-blue meander in the surrounding land, and diversity in landscape elements.
- Physical soil quality. Reduce and/or stop subsidence, waterlogging, sealing, wind and water erosion, and where possible rehabilitate. Maintain geological features in agricultural land. Maintain and extend the green-blue meander. Protect characteristic farming landscape.

STANDSTILL AND ALARA

The soil memorandum assigns a central role to the standstill principle in soil policy. This principle can be applied in different ways. European Soil Strategy is based on the DPSIR (drivers, pressures, state, impact and responses) concept (Blum & Varallyay, 2004). Human activities (drivers) create pressures on the environment and on the soil, which in turn cause changes in the state of the soil. Changes of state can lead to risks and damage (impacts). Society responds by formulating policies and measures. These responses can address the

drivers, the pressures, the state or the impacts. Standstill can in theory be applied to any of these elements, depending on the choice of the regulator. If standstill is applied lower down in this cycle, there will be consequences higher up, although the nature of these consequences is usually not clear in advance.

ALARA relates to emissions (pressure) into the environment and is closely related to terms such as best available techniques and best practicable means. ALARA acknowledges that some losses into the environment are inevitable, and that ‘technical’ means (technique, time, place) must be used to endeavour to minimise losses.

ALARA can be regarded as a special case of standstill in emissions: the emissions are fixed at the level permitted by technology. This level can be changed when there is an advance in technology. These principles usually relate to pollutants in the environment. In environmental policy the term standstill has usually meant preserving a given good environmental quality (Spaans, 2000).

The standstill and ALARA principles are applied within the context of a wide variety of environmental media, pollutants, pollutant properties, baseline situations and means of abatement. The Committee proposes that, when talking about standstill and ALARA in relation to nutrients and other pollutants in land-related agriculture, a third domain should be introduced, to give three domains: (1) buildings, (2) the topsoil (root layer) and (3) the environment. When considering substances we need to distinguish between those that are useful for or in buildings, installations and livestock, but possibly harmful to the topsoil and the environment (metals in fodder and veterinary products, pesticides) and those that are useful for the topsoil but possibly harmful to the environment (nutrients, pesticides). There is also a distinction to be made between pollutants which tend to accumulate (metals, phosphates, relatively persistent pesticides which adsorb) and pollutants which tend to spread (nitrate, metals, mobile and relatively persistent pesticides). And finally, the existing state of the topsoil in relation to the substances it needs must be taken into account: is there a deficit, sufficiency or excess? Drawing up general rules for applying the standstill and ALARA principles in land-related agriculture is therefore not a simple matter.

The use of the standstill principle for the quality of a given environmental medium will tend to perpetuate the existing situation. It can be applied if the existing environmental quality is good. It is also used when slightly contaminated earth is being laid on land, on the principle that the quality of the earth is comparable to that of the receiving soil. If the soil quality is not appropriate for the use, however, or the intervention value is exceeded, soil quality must be

improved. The Committee believes that where standards are being exceeded in the tillage layer or elsewhere, standstill should be at most a starting point, and that measures need to be taken to improve quality.

The standstill principle is often strongly criticised because it can lead to situations where ‘nothing else is permitted’. It has been seen that a policy for slightly contaminated land based strictly on the standstill principle considerably reduces freedom of action. In its report ‘Definition study on dredging spoil and soil’ (TCB, 2004), the Committee proposed a number of rules for applying the standstill principle to soil quality. The issue there was how to interpret the concept of comparable quality between the substance being applied and the receiving soil:

- almost identical composition and degree of contamination;
- not identical composition, but for different substances a comparable degree of contamination;
- comparable leachability;
- comparable quality in terms of suitability for use.

In that report the Committee also mentioned the existence of rules for applying target values (Ministry of Housing, Spatial Planning and the Environment, 2000) and the building materials (temporary exemption) decree 2004 (Ministry of Housing, Spatial Planning and the Environment, 2004). These showed that there are often no environmental problems with small differences in composition or leachability.

The report proposed the following order of preference in spreading dredging spoil which is not clean on land:

- apply subject to comparable quality and standstill criteria, within a defined area (municipality);
- apply on a less strict interpretation of standstill; the dredging spoil can be a little dirtier than the receiving soil;
- apply at a location in the municipality where poorer quality dredging spoil can be applied and a deterioration in soil quality is permitted (reasoned departure from the reference quality);
- store in a temporary depot to allow the quality to improve (breakdown of organic pollutants and improvement in microbial quality) before applying to the land.

In agriculture the standstill principle can be applied to different types of problem. The above rules could be used for applying materials to the soil which will form part of the soil, such as dredging spoil and compost.

MINIMUM AND DESIRED QUALITY

When setting minimum and desired soil qualities as goals for a more sustainable land use, regard must be had to the spatial scale which is most critical, and to the long term. Minimum quality can be taken to mean the minimum quality needed not only for agricultural use (in the long term), but also for the more general good. For most parameters the appropriate minimum or desired quality depends on the soil type. It is at present not really possible to give hard quantitative values for minimum or desired quality. There is for example a good scientific understanding of the relationship between organic matter and the propensity of soils to erode, become less fertile and compacted (Loveland & Webb, 2003; Verheijen *et al*., 2004; Tobias, 2004). Although the science does not permit us to derive hard and fast limit values for the organic matter content in soils, broad ranges can be indicated. There is however a rule of thumb for the organic matter content. It is assumed that, depending on soil type and texture, the topsoil loses its structural stability and becomes prone to erosion and desertification below about 2% organic carbon (approximately 3.4% organic matter) (Loveland & Webb, 2003).

A set of minimum quality criteria for agricultural soils could therefore be derived from the following:

- Organic matter: no minimum quality; some plants can be grown in extremely poor soil.
- Nutrients: depending on the state of the soil, in accordance with the Fertiliser Recommendations.
- Other substances: LAC warning levels (not yet developed for veterinary products).
- Functional biodiversity: no minimum level known.
- Physical soil quality: pore size in the soil must be sufficient to allow penetration of water and roots and sufficiently water-retentive to provide moisture to the crop, dependent on soil type.

The minimum quality from the wider viewpoint of society as a whole can be derived from the following:

- Organic matter: about 2% organic carbon, dependent on soil texture, having regard to leaching, functional biodiversity, change in land use, soil structure and water buffering capacity.

- Nutrients: the level at which there is no unacceptable evaporation or leaching out into the environment, and at which another land use could be implemented within a generation.
- Other substances: level at which there are no unacceptable emissions into the environment or toxic effects in the topsoil, and at which another land use could be implemented within a generation.
- Functional biodiversity: level at which another land use could be implemented within a generation.
- Physical soil quality: soil does not retain water so long that soil functions are impaired (e.g. soil productivity, nutrient intake and water buffering), no unacceptable subsidence, the area under cultivation must remain proportionate to the uncultivated area within the region. Construction and subsidence are matters sometimes outside the farmer's control.

The question arises whether there is, apart from the minimum quality, also a desired soil quality for different forms of sustainable agriculture. Generally, the desired soil quality in agriculture can be taken to mean the quality which optimises the agricultural yield (quantity and quality) while minimising the environmental impact so that other societal objectives such as the preservation of landscape features (e.g. cows grazing in pastures) are realised. Some soils are intrinsically better than others for particular crops, and some soils produce fewer environmental problems than others. Suitability for use should be an important factor in the choice of crops or even the type of farm. The Committee indicated in an earlier report that ecological services of the soil should be exploited to the full. This places demands on the chemical, biological and physical soil quality.

Desired soil quality on the basis described above will depend on soil type, water table level and the crop being grown. A comprehensive treatment for different soil types and cropping profiles is outside the scope of this report. Much is known of the natural suitability of soils for different forms of agriculture (see Ten Cate *et al*., 1995). Although this knowledge is often very much oriented towards adapting soils for a particular crop, it can also help us describe desired soil qualities in agriculture.

As far as contaminants are concerned, the desired soil quality can be based on the target values. A project has been started pursuant to the soil memorandum (Ministry of Housing, Spatial Planning and the Environment, 2003) to ascertain a reference for biological soil quality. This project is expected to produce proposals in the second half of 2005 for a measurable reference – i.e. desired – biological soil quality, including for agricultural land. The Committee expects to make recommendations in this regard in autumn 2005.

4 INSTRUMENTS

INTRODUCTION

Qualitative and quantitative objectives for different soil quality parameters for more sustainable land use were formulated in chapter 3. The Committee considers that more sustainable land use is a matter which concerns all strata of society. The main focus in this chapter, however, is on the public authorities, since the Committee's function is to advise government. The authorities have different instruments to realise their objectives for more sustainable land use. The Committee would like to draw attention to the following points relating to agriculture and the government's choice of instruments:

- Regulations can prescribe either means (e.g. technologies, deadlines, quantities) or the desired outcome (i.e. a specific environmental quality), without specifying the means by which this is to be achieved. Many regulations in agriculture are means-oriented, which farmers are finding increasingly oppressive.
- There is a growing desire amongst farmers to tackle environmental problems collectively. Region-oriented policy allows the poorer performance of some farms to be compensated by better performances of others. This approach acknowledges that farmers face a wide range of different circumstances. The question arises as to when it is possible and useful to resort to region-oriented environmental policy.
- The soil memorandum (Ministry of Housing, Spatial Planning and the Environment, 2003) announced that the present duty of care imposed by the Soil Protection Act on the user of the soil will be extended and made more operational. In elaborating this duty of care the government would like to see a distinction between the farmers' and more general interests.

The government expects a land user to manage that land in his own interests. But it would also like to encourage management methods which advance the wider interests of society. Such management could be rewarded financially. But to do this we must be able to distinguish between self-interest and the common good.

This chapter considers policy instruments, paying special attention to the foregoing points. There are also various parties who need to be able to ascertain how soil quality is responding to policies or local management. Different options for monitoring are discussed. At the end of the chapter, the Committee lists what concrete actions the different parties (farmers, agrichains, public authorities and society at large) could do first to contribute to a more sustainable use of agricultural land.

Outcomes and means

Many agricultural regulations prescribe means, i.e. the technologies or products to be used, the times at which an activity can be conducted and what should or can be done with the different waste streams. The advantage of means-oriented regulations is that they are unambiguous and usually easy to check. Their disadvantages are that they are usually very detailed, they are not always clearly linked to an objective and leave no room for individual choice. Only limited account is taken of the circumstances of the farmer, for example by specifying broad types of soil and water table level. The lack of choice means that the farmer cannot optimise his activities in function of his own personal circumstances.

Various parties have stated that they would like to work more with outcome-oriented rules. This gives greater responsibility and choice to the individual soil manager, in this case the farmer, as to the means by which the objective is met. The Committee considers that there could be a system in which farmers are made accountable at the level of the individual farm, or at area level in the case of environmental cooperatives, for a clearly stated set of objectives for the topsoil and the environment. It would be up to the farmer or environmental cooperative how these objectives are met through the farming methods employed. The government could assist by providing information on methods, including economic information, by which the objectives can best be met. It would of course be necessary to monitor the quality of the topsoil and the neighbouring environment in relation to the objectives, which would have the added advantage of providing a good picture of the rural environment.

In the Committee's view the following criteria would have to be met:

- The relationship between different soil management regimes and the objectives to be achieved must be well understood. The objectives must respond relatively quickly to the methods adopted; change must be visible and/or measurable.
- The set of objectives must be systemic and formulated for the long term. The achievement of one objective must not make the others infeasible. The objectives must be such as to offer complete long-term protection of the environment and allow the use to be sustained.
- Objectives must be measurable and results attributable to the individual, or area management.

In view of the above it is clear that there is a lot to be done before effective outcome-oriented regulation can be put in place. Indeed it is questionable whether it is possible at all. Farming in the context of outcome-oriented regulation demands a lot of knowledge, as well as a certain trust between regulator and farmer, because enforcement is at one remove. Furthermore, an objective comprising a minimum or a desired soil quality is scientifically difficult to establish. Managing the soil exclusively on the basis of a target soil quality is also difficult, because the soil responds very slowly and signals that a change is needed in the use or management of the soil often come too late. This may not apply to shallow groundwater. Quality objectives may form a good basis for managing groundwater, for example the limit value for nitrate in the EU Nitrate Directive or the future EU Groundwater Directive.

It is important to link a spatial scale to this type of objective, so that it is clear whether emissions can be 'swapped' between farms (see next section).

Region-oriented environmental policy

Region-oriented environmental policy in agriculture involves looking at the environmental performance of an area or region rather than that of a farm. The farmers in the area may for example have joined together in an environmental cooperative. An advantage of the approach is that within the area more poorly performing farms can be offset by better ones. There needs to be sufficient heterogeneity in the area so that there are differences in performance. Another advantage is that farmers who depend on each other's performances will want to learn from one another and will apply a social control.

Region-oriented environmental policy only makes sense if the environmental policy is formulated in terms of outcomes. A policy formulated in terms of means to be applied by farms does not allow trade-offs between farms or learning from one another. Region-oriented environmental policy is only of benefit if objectives relate to and are measurable for the area, such as the mean groundwater content in an area or the total permitted emissions to air in an area. There is little experience of formulating such objectives.

Apart from the problems described above in regulating outcomes, outcome-oriented regulations serve to delimit problems where region-oriented environmental policy offers a solution. Generally speaking, region-oriented environmental policy is more suitable for problems which occur close to the farm and where there is a spatial displacement of the problem; for example nitrate in the groundwater or water buffering in an area.

Duty of care

The duty of care for the soil falls primarily on the user. The duty of care is defined as follows in the Soil Protection Act: '*Any person carrying on activities in or on the soil [….] and who knows or might reasonably have supposed that those activities can contaminate or impair the soil, is required to take all measures which can reasonably be required of him to prevent such contamination or impairment, or if such contamination or impairment should occur, to clean up the soil or to limit and as far as possible reverse the impairment and its direct consequences*.'

The question arises as to how far government can go in imposing rules on land use. Farmland is after all usually owned by the user. Property law in the Dutch Civil Code states: '*The owner, to the exclusion of all others, shall be free to use his property, provided that this use does not conflict with the rights of others and that in so doing he has regard to the limitations set by statutory provisions and common law'*. A first justification for promoting more sustainable land use relates to the 'rights of others', i.e. that neighbours should not be subjected to nuisance or harm. This means that the area around a farm, whatever the characteristics of that area, should not be adversely affected by the use of the land. A second justification relates to 'the limitations set by statutory provisions and common law'. The government can impose legal requirements which constrain the way an owner manages his property. This idea is also expressed in the clause in the Soil Protection Act dealing with duty of care. Similar situations arise in the case of house owners, who can be obliged to make home improvements and in the case of major works to comply with government regulations (building permit) requiring them, for example, to improve the social and economic condition of a neighbourhood.

Activities are a central concept in soil management and in the Soil Protection Act. Their impact on soil quality varies from those that cause damage to those that maintain it in a sustainable manner. Activities are inseparable from use: soil use involves carrying out activities on or in it. Taken together, the activities conducted on and in the soil can be called 'management'. Farmers have always been soil managers; they manage (work and maintain) the soil for production purposes. It is in farmers' own interests to do so, to generate income.

The government needs to distinguish between activities which can be expected of a soil manager (farmer) because they are in his own interests, and activities which transcend self-interest, for which he might be recompensed. The Committee understands that this distinction is relevant in the choice of instruments.

In the context of more sustainable land use, it can be assumed that self-interested soil management can ensure that the soil produces an acceptable yield for a span of years without impacting on the environment. Not impacting on the environment is not the result of self-interested behaviour, however, but a requirement imposed by society. It is in the public interest. It is apparent that with the means and technologies currently available, farmers can in the short term operate almost independently of soil quality, so that in the short term they are not driven by strict self-interest to manage the soil. And long-term considerations do not now weigh heavily for economic and sociocultural reasons (farms not passing to next generation, urbanisation).

Adverse impacts of agriculture on the environment which run counter to the general interest (clean water (including groundwater), clean air, nature conservation) are prevented or limited through prohibitions and obligations. Not all adverse effects of agriculture are, however, controlled through regulation in this way. Meadow birds, for example, are coming under pressure as a result of meadow management practices. This must be regarded as a negative effect of agriculture, although in this case not in the neighbourhood of the farm but on the farm itself. In such a case the government opts for an incentives-based rather than a regulatory approach. It seems that if the general interest can only be served on the farm itself (in the topsoil), the government often opts for incentives, even when dealing with negative effects of agricultural practices. There is something to be said for this approach, which recognises that not everything can be done at once on a single piece of land (see guideline two in chapter 3). In fact the farmer is recompensed for curtailing his land use for the benefit of another use on his farm. To generalise this rule, a farmer would be recompensed if society makes use of the farm (the topsoil) in order to realise its own objectives. In order to qualify for recompense, however, the farmer must incur demonstrable costs (in terms of labour, land or money).

Of the objectives for more sustainable land use named by the Committee in chapter 3, the following would qualify for subsidy:

- managing the organic matter content to allow future changes of land use, or to comply with the Kyoto Protocol;
- discontinuing certain husbandry methods or soil treatments, or the cultivation of certain crops;
- creating or managing the green-blue meander and/or landscape features on the farm;
- Maintaining geological features on the farm.

Objectives such as the prevention of subsidence, sealing and wind and water erosion are societal objectives, but are also greatly in farmers' own interests, particularly in the long term. These would not qualify for subsidy. It therefore appears that only a limited proportion of what the Committee understands by more sustainable land use would qualify for subsidy. The other objectives mentioned by the Committee relate to the ongoing prevention or reduction of adverse effects in the vicinity of the farm or correspond to the farmer's own long-term interests.

The Committee has studied a recent report on incentives for sustainable land use in agriculture (EC-LNV, 2004). This report considered measures related to sustainable land use which might qualify for subsidy because they promote an objective of society as a whole. The claim of a particular measure was assessed on the basis of a number of criteria, including cost-effectiveness, feasibility for farmers, support among decision-makers, financing possibilities, verifiability, enforceability and the administrative burden for farmers. After applying these criteria, only a small number of measures emerged which would have a good claim to a subsidy.

INDICATORS

Indicators can be used to determine the direction in which land use is developing and to suggest where it should be heading. In its report 'Towards a more ecologically sustainable land use' (TCB, 2003), the Committee looked at state indicators for the soil. In regulating individual farms it can be more practical to work with use indicators. This section will concentrate on indicators for sustainable land use and both types of indicator will be discussed.

There is at present a great deal of discussion in the scientific community about indicators for more sustainable land use or sustainable agriculture. Some advocate holistic systems for agriculture, where indicators are defined for the soil, the effects of agriculture on other environmental media and all kinds of social and economic aspects (Van Cauwenbergh *et al.*, 2004). Others take the traditional set of soil parameters as a starting point and try to classify them as indicators according to soil threat (Blum & Varallyay, 2004). Large-scale systems of this kind are currently confined to the realm of scientific discussion. Given the need to gain practical experience, a limited selection of indicators seems more reasonable. See for example Sparling *et al.*, 2003.

Indicators can be used to show whether the criteria for more sustainable land use are being met. Indicators must be:

- Relevant: the indicator must relate to what is being studied.
- Controllable: there must be an understanding of how the value of the indicator can be influenced.
- Quantifiable: it must be known what values the indicator can take.
- Normative: it must be possible to attach a meaning to the value of the indicator (good, bad, large, small) or it must have limit and/or threshold values.

Attractive properties of indicators are: comprehensiveness (affected by a large number of factors), ease of observation and meaningful to the general public. In the United Kingdom, for example, the 'agricultural bird population' is seen as a key indicator of sustainability in agriculture (see box). The Committee considered whether it would not be possible to make do with a single indicator of the sustainability of agricultural land use. For more sustainable land use, the organic matter content of the soil is often seen as a comprehensive indicator, because organic matter is related to soil fertility, physical soil quality, moisture retentiveness, functional biodiversity and resistance to disease and pests. In the view of the Committee, organic matter has good potential as an overall indicator of more sustainable land use, but certainly does not encompass all aspects of the sustainable use of agricultural land.

Box (RSPB, 2003).
United Kingdom: many actors involved in promoting sustainable agriculture
In the United Kingdom (UK) farmers are seen as guardians of the landscape and the providers of public services. In the context of sustainable agriculture, there is concern about small high-tech companies that increasingly move into the rural countryside. In fact, rural communities are dependent on farming in some areas, including mountain farming areas. Long-term viability of agriculture is critically affected by the age of farmers and the perspective for continuation of farming. There is serious concern on the part of the farming community about international competitiveness and farmers argue overwhelmingly that their practices should not be regulated further. There is concern on the part of the farming community about the implementation of the Water Framework Directive, and the possible high costs involved in meeting its requirements. Sustainable agriculture is not seen as the main trend for the future. The Sustainable Development Strategy is currently being reshaped, essentially aiming to develop a toolkit for sustainable development. The focus is also on sustainable land use, and critical to its achievement is how environmental targets are delivered in agriculture.

Public authorities are keen to make operational the degree of integration of the environment in agricultural practices. Rather than developing a set of indicators of sustainability, emphasis is given to indicators that can be operationalised. Measures of rarity of flora and fauna were designed, and gradually moved into the establishment of management agreements. The

importance of this trend is also reflected since ‘agricultural birds’ is a key indicator used by the Department for Environment, Food and Rural Affairs (DEFRA) in their attempt to operationalise sustainability. It was chosen because it is perceived as a good measure of sustainability in agriculture. Birds are sensitive indicators of the health of the environment and sustainability, being responsive to change, high in food chains, inexpensive to survey and a widely known component of Europe’s wildlife. Populations of farmland birds have nearly halved since the late 1970s, and modern farm management practices have contributed to the decline. The index of farmland birds has stabilised since the mid 1990s.

State indicators for more sustainable land use

In its report ‘Towards a more ecologically sustainable land use’, the Committee stated that an ecologically healthy soil which can deliver ecological services is the basis for more sustainable land use. The discussion of indicators in that report related to indicators of the health of the soil itself. The Committee stated then that a set of soil parameters can be defined on the basis of present science which represents the extent to which the soil is ecologically healthy and can perform ecological services. This set is known in the Netherlands as BoBI (acronym for soil biological indicator), but comparable indicator systems have been proposed in Denmark, the US, Australia and New Zealand. There is as yet little experience of the routine use of indicators of this type. Experience is needed because there are not any independent reference values against which they can be tested. The indicators are like a set of thermometers with different scales and no zero. The desire for a ‘soil thermometer’ to measure the health of the soil is therefore a long way from realisation. This problem is often tackled by working with ‘amoebas’ (Dutch acronym for ‘general method for ecosystem description and assessment’) where the value of the indicators is expressed relative to a reference situation. This can for example be derived from organic farms or a historical situation deemed to be ‘good’, such as agriculture before mechanisation and the widespread use of pesticides. A problem with this method is that the choice of reference situation usually generates vigorous argument, because it is so normative. This choice is therefore a political one.

An improvement or deterioration in a system is generally reflected in a movement in the values of the state indicators in a particular known direction. It is also possible to demonstrate the effect of given interventions or forms of soil management on different parameters. If repeated measurements are made over time, it is possible to indicate whether there is a positive or negative trend. The reason for this trend can often be found in the manner in which the soil was used and managed. Once sufficient experience has been gained with the indicator, the land use or soil management can be modified so as to

eliminate negative effects and promote positive trends. In other words, empirical research based on indicators such as BoBI can help to determine how soil quality should be managed.

Use indicators for more sustainable land use

Use indicators can show the extent to which a particular land use has met the objectives for sustainable land use at the farm level. They correspond with the pressure or risk indicators referred to earlier. In other words they are indicators which reflect directly how the soil is being used rather than the state of the soil itself. The following soil use indicators, which can be determined for individual farms, suggest themselves:

- **Organic matter balance**. By recording the inputs of organic matter into and the outputs from the farm, and linking these with periodic measurements (every five years, say) of the organic matter content in the topsoil, an insight can be gained into the sustainability of the farming practices employed. Other indicators might be the frequency and area of pastureland ploughed up and of deep ploughing.
- **Nutrients balance**. Recording the inputs and outputs of nutrients for a farm, as is done for example under 'MINAS' (Dutch mineral accounting system), can indicate how close the present farming regime is to achieving a sustainable balance.
- **Balances for other substances**. These substances would be metals, persistent organic compounds, veterinary products and pesticides. Clearly the analysis needed to draw up such balances will be costly. It is however quite possible to make estimates of inputs and outputs based on the composition of products arriving at the farm (animal feeds, manure, compost) and the composition of products leaving the farm. The times required for organic compounds to be broken down can be estimated from the technical literature and adjusted on the basis of empirical research on a number of farms. It will be clear that this balance only reflects the inputs and outputs of substances resulting from agricultural use and how the farming regime needs to be improved. The soil is also subjected to considerable contamination from atmospheric deposition, but this cannot be monitored at the farm level. It is largely the job of government through its environmental policy to ensure that atmospheric deposition is brought to a level where it is in balance with natural removal processes (chemical breakdown, leaching out). The objective is first to bring inputs and outputs into balance with one another and in the longer term to reduce levels in the soil by reducing inputs and/or stimulating removal through breakdown.

The following parameters are not expressed as a balance between inputs and outputs. Monitoring state parameters can provide insights and be used as an indicator of more sustainable land use:

- **Maintain soil biodiversity to promote resistance to disease and pests**. In the topsoil, the organic matter balance would suffice. Other indicators include the extent of crop rotation practised, the extent of the green-blue meander, the presence of small-scale landscape features and the presence of unfertilised/unsprayed field margins.
- **Physical soil quality**. Indicators are root penetrability (soil pores), extent of wind/water erosion, soil aggregation, infiltration capacity, waterlogging, rutting, frequency of crop rotation, frequency of deep ploughing, density of cultivation (for example, greenhouses), ground subsidence and the area of characteristic landscape.

Since soil responds only slowly to human activity and a deterioration is usually difficult to remedy, the Committee considers it preferable that use indicators be used where possible.

CONCRETE MEASURES TO PROMOTE MORE SUSTAINABLE LAND USE

This section summarises the measures which, in the Committee's view, will make an important contribution to making land use more sustainable in different sectors of agriculture. The Committee has made a preliminary selection of measures, on the basis of expert judgment. In addition, an Alterra working group[7] considered how a more sustainable land use could be encouraged. These experts maintained that it would be easier to say what is non-sustainable than to make suggestions as to how more sustainable land use can be encouraged. It is self-evident, however, that land use can be made more sustainable by providing stimuli for more sustainable alternatives, or discouraging or banning non-sustainable forms of use.

An attempt was made to draw up a relatively short list of measures which would promote more sustainable land use. These were grouped according to the actors who would have to take the measures: farmers, production chains, society at large and the authorities. The Committee confined itself to areas not already dealt with in these terms in this report. There is also a role for research institutes and consultants, but these will be called in by the other actors for specific specialised issues. Where possible the relevant soil quality parameter is indicated when the measure is presented:

• OM=organic matter;
• N=nutrients;
• OS=other substances;
• BIO=functional biodiversity;
• PSQ=physical soil quality.

[7] See footnote 6.

Where possible we also indicate whether the sustainability effect occurs in the topsoil (also in the farmer's own interest) or elsewhere (e.g. in the immediate environment or globally).

Possible measures for farmers

- Use extensive crop rotation, avoid monoculture (OM, BIO) (topsoil and wider environment).
- Take account of soil type and soil quality in cropping plan (all parameters) (tillage layer and wider environment).
- Fertilise according to the needs of the crop and the carrying capacity of the local soil-water ecosystem rather than using norms or the storage capacity of the manure/slurry cellar (N) (wider environment).
- Treat and remove manure from intensive animal husbandry (for example co-digestion) (N) (wider environment).
- Develop methods for ensuring that even fairly intensive agricultural practices are associated with low environmental impacts (all parameters) (wider environment).
- Modify, avoid, relocate or discontinue the cultivation of inefficient crops and/or crops with very high nitrogen requirements (N) (wider environment).
- Adopt system innovation in dairy farming (robust, healthy stock, use home-grown roughage, reduced use of feed concentrates and veterinary products) (N, OS) (topsoil and wider environment).
- Develop smaller, lighter machinery for tillage and manuring (PSQ) (topsoil).
- Accept sub-optimal water table levels (PSQ) (wider environment).
- Avoid invasive working of the soil (heavy machinery, deep ploughing, ploughing up meadows) (PSQ) (topsoil and wider environment).

Possible measures for the production chains

- Develop and implement a code of good practice for chain producers with guidelines for sustainable land use (certification).
- Process/trade only those products grown in accordance with proven good agricultural practice.
- Pay reasonable prices, certainly not below cost, for products, whether local or international.
- Conduct public information campaigns to raise consumer awareness of the importance of more sustainable land use. Raise consumer awareness of the consequences of unsustainable land use.

Possible measures for society at large

- Demand information on cultivation methods, country of origin, processing and prices paid for products (role for consumer organisations).
- Use this information to inform consumers about the sustainability of products.

Possible measures for the authorities

- Relocate intensive forms of agriculture, through the planning system, to environmentally more suitable land (high fixing capacity, good structure) (topsoil and wider environment).
- Use vulnerable land for extensive agriculture/nature conservation (topsoil and wider environment).
- Introduce maximum livestock units per hectare for non-intensive livestock and dairy farming (N) (wider environment).
- Regulate the water table and surface water levels on the basis of the wider demands of society (PSQ) (wider environment).
- Provide quality assurance of produce through certification and labelling (OS) (topsoil).
- Tax phosphatic fertilisers (N) (wider environment).

5 SPECIFIC QUESTIONS RAISED

In the preceding chapters the Committee has examined the issues raised in the request for advice in so far this was possible within its constraints, arranging the material in its own way. In this chapter the relevant findings of the Committee are presented in the form of conclusions and linked to the questions in the request for advice from the Minister of Agriculture, Nature and Food Quality.

WHAT IS SUSTAINABLE LAND USE IN AGRICULTURE?
What does the sustainable use of agricultural land mean in the context of existing instruments such as the soil memorandum, the Soil Protection Act, the European Soil Strategy, etc.? I would like to see the concepts and policy assumptions applied specifically to agriculture. For example what does the standstill principle mean for agriculture, how might it be applied to agriculture and is this practical, what is admissible and what inadmissible (given that any activity in the soil is associated with losses and/or impacts), how should the general duty of care be interpreted in agriculture? Please indicate the Committee's points of departure and the consequences and the pros and cons of each possible approach, particularly in relation to the environment and the feasibility of the approach for the agriculture sector.

The point of departure for the Committee in drawing up this report was the Soil Protection Act, which focuses on activities and is based on duty of care. It is assumed in this report, as in the soil memorandum, that land use confers rights and entails duties. In view of the current status of the European Soil Strategy, the Committee confined its attention to the themes in the Soil Strategy and made use where possible of the DPSIR (Drivers- Pressures-State-Impact-Response) model.

Standstill means the same in relation to agriculture as it does in other contexts. The Committee refers to earlier reports which explored the principle and its application. The standstill principle need not only relate to environmental quality (state variables), but can be applied to other elements in the DPSIR model, depending on the parameter which is best managed. Where standstill is not a practical approach, because leakages always occur to some extent, the ALARA principle may be useful. In one sense ALARA is a special case of a standstill applying to emissions (pressure). In relation to the question about admissibility or otherwise the Committee takes the view that it is not acceptable that agriculture should cause adverse impacts on the environment. The term environment here is taken to mean all

environmental media other than the topsoil (or the farm): the air, the deeper soil including groundwater and surface waters with their sediments.

In regard to duty of care the Committee has distinguished, at the request of the government, between farmers' interests and the public interest. The Committee considers the circumstances in which farmers should qualify for financial incentives where they have a duty of care towards society at large. It is concluded that only a small proportion of the objectives formulated by the Committee for more sustainable soil policy should qualify for subsidy; more sustainable soil policy is still largely about tightening regulations and improving enforcement. The Committee also discusses a number of matters and limitations related to outcome-oriented and means-oriented regulations as well as region-oriented environmental policy.

In relation to feasibility, the Committee points out that the economic and sociocultural dimensions of sustainability have much shorter critical timescales than ecological sustainability. But short-term considerations should not always predominate; it is very important to take a long-term perspective in considering more sustainable land use.

What possible criteria and indicators are there for the sustainable use of agricultural land? How can the sustainability of agricultural land use be measured and assessed? How useful are indicators currently in development such as the soil biological indicator (BoBi), the organic matter content and the 'soil thermometer'?
A distinction is made in the context of more sustainable land use between state indicators and use indicators. State indicators describe the soil quality. Organic matter content is quite a good summary state indicator of sustainable land use, but it does not cover the entire range of sustainability issues in agriculture. State indicators were discussed in detail in an earlier report (TCB, 2003). Use indicators tell us about the activities which a soil manager (the farmer) performs at the farm level. These indicators often take the form of mass balances and are similar to accounting quantities. Because the soil responds slowly to human activities, and degradation is usually difficult or impossible to remedy, the Committee considers it preferable to regulate by means of use indicators where possible. Considerable experience has been acquired in using indicators of this kind for nutrients in the MINAS scheme. There appears to be acceptance of the principle of drawing up mass balances for heavy metals at the farm level.

What might the sustainable use of agricultural land look like (scenarios showing the consequences for the 3 Ps, and seen in the context of sustainable development: here, now; there, later)? Please differentiate by geographical scale and the responsibilities of different

administrative levels. What will sustainable use of agricultural land look like at the EU, national, regional and farm levels (per soil type and for each land-extensive sector: dairy, arable, fruit, bulbs and open-air horticulture)?

Given the function of the Committee, it has addressed the ecological dimension of more sustainable land use. The Committee considers that trade-offs in regard to issues of sustainability need to be made at the political level. The Committee took as its preliminary definition of more sustainable land use from the perspective of soil protection *'preventing adverse impacts of land use elsewhere and in the future, being able to maintain the land use in the long term, ensuring that other land uses can be practised in future, and preserving ecological services of general importance'*. The concept of more sustainable land use is then made more tangible by formulating qualitative and/or quantitative objectives for five soil quality parameters, based on guidelines for the use of soil ecosystems. Consideration was also given to concepts relevant in formulating these objectives, such as standstill and ALARA, minimum and desired soil quality.

Is there a minimum soil quality (chemical, physical, biological) which the government should set for the sustainable use of agricultural land? Please give some indication of how the minimum quality could be determined and identify any gaps in knowledge. A distinction should be made in so doing between the short and long terms. What is the desired quality for agricultural soil (quality reference values which indicate that the soil is suitable for the function)? For the moment this question should be addressed in a qualitative manner and indicators should be identified if possible.

The Committee concluded that it is at present not really possible to give hard quantitative values for minimum and desired soil quality. As far as the minimum quality is concerned, we have indicated what this value might be based on, from the viewpoint of the farmer's interests and those of society as a whole. As regards desired soil quality, the Committee has stated that in general terms this is the quality which optimises production in both quantitative and qualitative terms, while minimising the environmental loading, thereby meeting societal objectives. The Committee has indicated that before it expresses its opinion on this matter it would like to see the outcome of the follow-up work on the concept of reference values for biological soil quality in the soil memorandum. For soil contaminants reference can be made to the target values and LAC warning levels. As far as the desired quality is concerned, the concept of 'suitability for use' should play an important role in the choice of tillage type or type of farm. The Committee has already pointed out that the soil responds slowly to human activities, and degradation is usually difficult or impossible to remedy. This means that for the moment it is preferable to regulate activities rather than trying manage soil purely by monitoring soil quality.

WHAT ARE THE ROLES OF THE VARIOUS ACTORS AND, IN PARTICULAR, THE GOVERNMENT?

What is needed to implement the sustainable use of agricultural land?
In the Committee's view, more sustainable land use will have a chance of succeeding if it is economically viable for farmers, there is mutual trust between the government and the farming community, objectives for sustainable land use have been formulated in a systemic manner for the long term, and if society and government call upon the production chain to produce and deliver food more sustainably.

What is the role of government (EU, national, provincial and municipal) and of industry?
The EU has increasingly imposed tasks on farmers as a result of changes in the common agricultural policy and the introduction of the Water Framework Directive, the Nitrate Directive and the expected soil strategy. The EU, but also national government, could for example play a role in relation to the WTO in making sure the ecological dimension of sustainability is properly promoted. The Committee considers that one task of government should be to provide the legal framework for regulating the negative effects of agriculture on the environment, and enforcing the rules. Another task is to be the guardian of the general interests of society as a whole. The Committee has stated that farmers could be recompensed if society makes use of the farm (the topsoil) to further its objectives. The farmer would however have to demonstrate that he has incurred costs (in terms of labour, land or money) to qualify for payment. The Committee has formulated a number of concrete measures for farmers, production chains, society and government. The production chains and society generally need to be driven much more in their actions by considerations of sustainability. More public information is needed in this area.

How can linkages be established with the transition to sustainable agriculture?
The Committee sees more sustainable land use as one component of the transition to sustainable agriculture, and feels that this component has so far only received modest attention. More sustainable land use can help give direction to the transition to sustainable agriculture by providing a basis for the necessary innovation on farms. More sustainable land use in agriculture can contribute in this way to the clean production of safe food, to nature conservation and biodiversity, and help preserve characteristic landscapes and a thriving rural community.

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